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Attention: Dr. T.L.K. Smull, Director

Gentlemen:

This is the 7th quarterly status report on contract No. NASr-54(03), covering the period August 1, 1964, to October 31, 1964.

The project effort during this quarter was divided among the following 5 tasks.

1. Analysis of data obtained on previous balloon flights.

2. Design and construction of equipment for the next balloon flight.

3. Analytical study of atmospheric radiation processes.

4. Development of an infrared interferometer for space craft use.

5. Report Writing.

The interferometer development received the major portion of the work effort. However, during August, the tempo of the interferometer development was decreased considerably in accordance with a more stringent budget than had been anticipated. Temporary student assistants were terminated and permanent staff members were encouraged to take as much of their accumulated vacation as possible. New dates for completion of engineering and scientific interferometer breadboards were set. Details of progress in each of the above 5 areas of work effort are given below.

1. Analysis of Data Obtained on Previous Balloon Flights

The analysis of the 26 June, 1963 balloon flight data continued.

The data for all 5 channels of the NIMBUS MRIR radiometer were digitized and stored on magnetic tape in IBM 7090 compatible form. It is planned to continue the analysis of this data on the IBM 7090 computer. Computer programming for this analysis was started.

Members of our laboratory participated in the evaluation of bids for the new data processing system being procured by the Space Physics Research group for joint use with our laboratory.

2. Design and Construction of Equipment for the Next Balloon Flight

The second environmental test to check the thermal control of instruments on the new balloon gondola was run at Chrysler Missile Division during the first week in August. The data obtained indicate that the present design is a satisfactory solution to the problem of the temperature control on the balloon gondola of the SIRS instrument and the JPL spectrometer.

The construction and testing of equipment for use on the next balloon flight continued. Mechanical items worked on were the following: layout and fabrication of the insulated compartmentalized battery section, mounting arrangement for the JPL spectrometer and cryogenic cooling system, gondola support cables and the crash pad for absorbing shock on impact. Electrical and electronics devices completed included the instrument programming and control chassis, in-flight telemetry calibration units having excellent temperature stability, a telemetry discriminator input patch panel, and a galvanometer attenuator panel.

A new time code generator was received, completely tested and installed in the telemetry ground station in the bus.

A program of modifying some used voltage controlled oscillators (VCOs) for possible use in our airborne telemetry system on future balloon flights was begun. The objective was to change the range of input voltages which the VCOs would accept. It was not possible to make this modification and maintain the necessary linearity of the VCO modulation characteristic and so this project was stopped. It will be necessary to purchase new VCOs.

The effect of a change in VCO input resistance on the accuracy of data telemetered over a channel using that VCO was investigated. It was found to produce negligible error in most cases. In the case where 0.2% of full scale accuracy is desired this factor must be carefully considered, however.

Methods of telemetering the relatively high frequency digitized interferometer signal along with the rest of the rather large complex of signals was considered. Various combinations of IRIG standard channels on one or two transmitted carriers was studied. The use of a second transmitter was decided against. If necessary time sharing of some of the signals will be instituted.

Test of the compatibility of tapes made on the Precision Instrument PS207 and the Ampex CP100 tape recorders showed poor results. It is suspected that the

CP100 tape recorder is not properly adjusted and so the services of an Ampex service technician were ordered.

A series of tests of an angular rotation commutating device were made to determine angular accuracy and repeatability. This device will be used with a photocell to determine gondola azimuth relative to the sun. These tests indicate that an accuracy of 1 degree in azimuth will be possible.

3. Analytical Study of Atmospheric Radiation Processes

The study of atmospheric transmission in the 15 micron CO_2 band continued. During this period a calculation of transmission coefficients in the entire band was made at the NCAR computing facility in Boulder, Colorado. The data obtained were prepared for publication. Comparisons with previous theoretical and experimental results are being made and applications are being considered.

Some time was devoted to improving the efficiency of the computer program for calculating absorption coefficients when both Doppler and Lorentz broadening are considered. Some consideration was given to the possible influence of variation in line half-width with rotational quantum number in radiation transfer calculations.

A program for the calculation of 15 micron CO_2 transmissivities with improved accuracy has been started.

4. Development of an Infrared Interferometer for Spacecraft Use

The main objective of the interferometer development was the integration of The University of Michigan optical cube with the NASA electronic circuitry. The objective was met to a large degree in that successful operation of the drive amplifier and mirror drive system was demonstrated and proper operation of the logic circuits was indicated.

The most significant development during this work period was that of the internal magnet mirror drive system. The previous model was constructed with ceramic magnets and "w" shaped springs. It was used to test the NASA electronic circuitry and was turned over to NASA Goddard Space Flight Center technical personnel after the initial tests. The new model was made with Alnico magnets and parallel leaf springs. The Alnico magnets were used because they have higher flux density than the ceramic magnets. This permits a design with magnets of smaller cross section, which in turn permits the magnet to be inside of a soft iron structure, with the final result that the external flux is greatly reduced.

Some of the other design, construction and testing details connected with the interferometer development are as follows. Various thicknesses of KBr beam splitter material were coated with Germanium. The proper thickness of the Germanium coating was determined, both for the infrared and for the visible light signal. Some optical tests of Irtran were conducted to check its suitability as a beam splitter. Protective coatings for KBr were tested. Vibration tests of a KBr beam splitter and mirror holders were successful. Several sources of light for the monochromatic signal were tested as were several types of silicon photoelectric cells. A new engineering breadboard optical cube was designed. Two fixed mirror mounts were built for use with the new optical cube. Finally a test of the scientific breadboard unit using the 0.25 in. KBr beam splitter, observing a target through a polystyrene filter, yielded a signal to noise ratio of 225 to 1, which is low by a factor of 8 from the desired signal to noise ratio.

A separate development of the electronic portion of the mirror drive system, parallelling the NASA development was carried out at The University of Michigan. During this work period, it became evident that the NASA development showed greater promise than The University of Michigan work and therefore the latter effort was terminated.

5. Report Writing

A paper, entitled "Infrared and Visible Radiation Measurements by Radiometer and Interferometer on High Altitude Balloon Flights at 34-Km. Altitude," by F.L. Bartman, L.W. Chaney, P.A. Titus, and M.G. Whybra was presented at the International Symposium on Radiation Processes at Leningrad, USSR, August 5-12, 1964.

6. Summary of Future Work

The following tasks will receive major attention during the next work period.

a. Development of the infrared interferometer.

b. Analysis of data from the last balloon flight and from the aircraft flight tests.

c. Design, construction and testing of equipment for the next balloon flight.

d. Analytical study of atmospheric radiation processes.

e. Report writing.